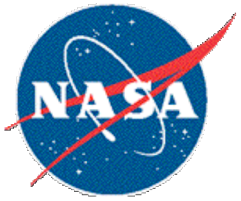


NASA Aerospace 2002
Turning Goals into Reality Conference

Executive Issues: Perspectives on the Future of Aerospace
Aerospace Technology and the Government Role

May 22, 2002

Santa Clara, California

Richard Golaszewski, Executive Vice President
GRA, Incorporated

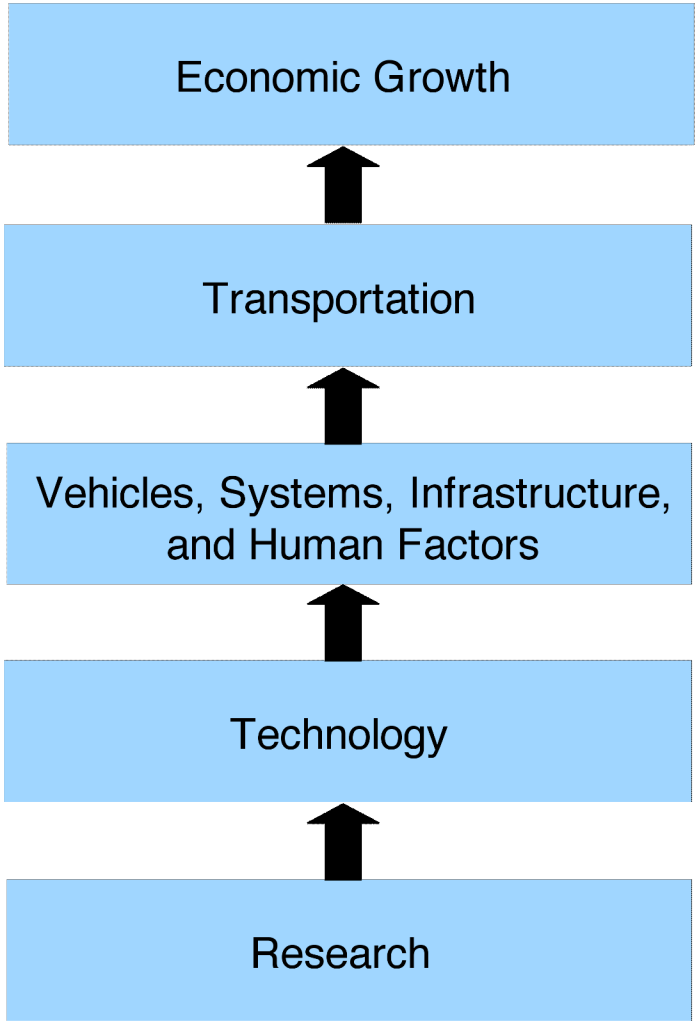
115 West Avenue • Jenkintown, PA 19046 • USA
Telephone: 215-884-7500 • Fax: 215-884-1385
E-mail: richg@gra-inc.com

THE U.S. GOVERNMENT ROLE IN AEROSPACE

Overview

- Long history of funding civil and military aerospace R&D
- Industry has undergone decade of consolidation raising questions
  - Does government still have a role in funding R&D?
  - What is unique about aeronautics?
  - Is there sufficient competition among firms?
  - Why doesn't the private sector invest enough in R&D?
  - Are aeronautics/aviation mature technologies?
- Current trends in government R&D expenditures and loss of U.S. market share seem to be related

RESEARCH AND DEVELOPMENT UNDERPINS TRANSPORTATION'S IMPACT ON THE ECONOMY



ECONOMIC IMPACT OF AVIATION INDUSTRY

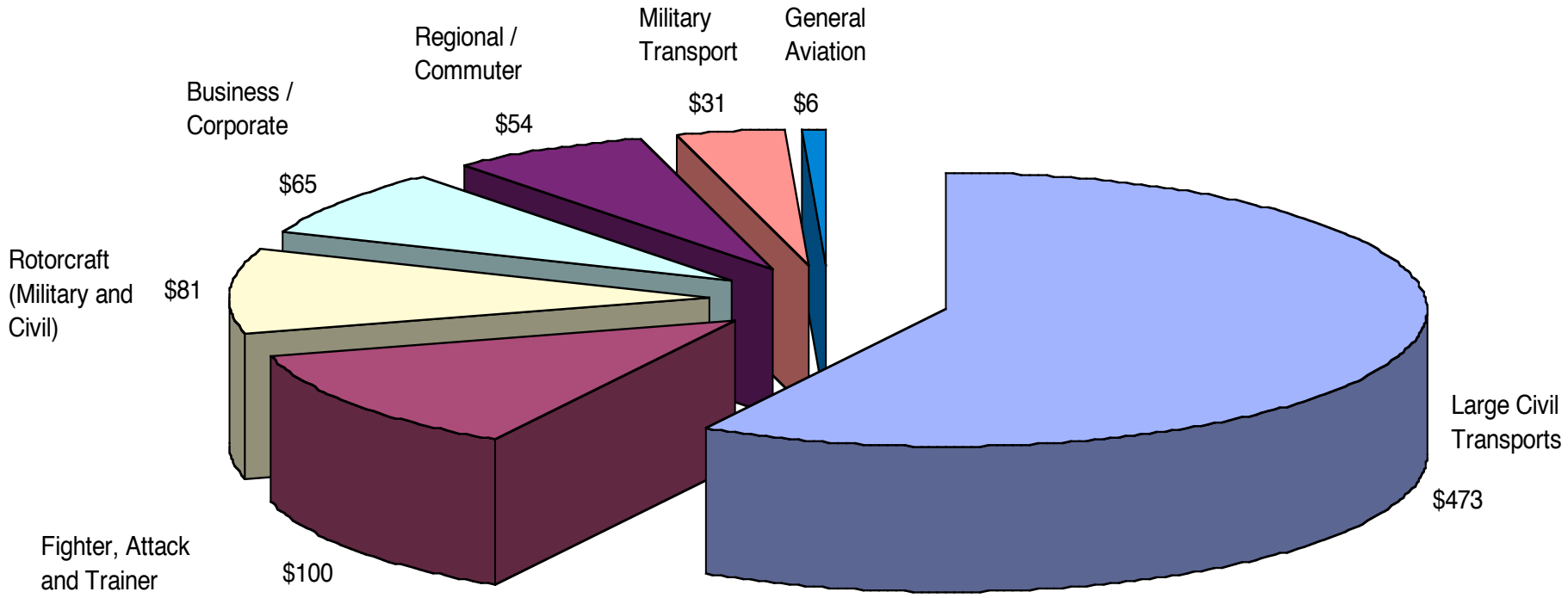
Estimated Economic Impact
by Air Transportation and Related Sectors
($ billions 1999)

	Total Output	GDP Contribution
Air Transportation	$205	$80
Aircraft Manufacturing	$134	$94
Tourism	$94	$85
Agents/Forwarders	$3	N/C
Government	$2	N/C
Total Impact	$438	$259

N/C = not calculated
Source: National Research Council, ASEB, "Recent Trends in U.S. Aeronautics Research and Technology," p. 8.

FUTURE MARKETS FOR AERONAUTICS PRODUCTS ARE LARGE

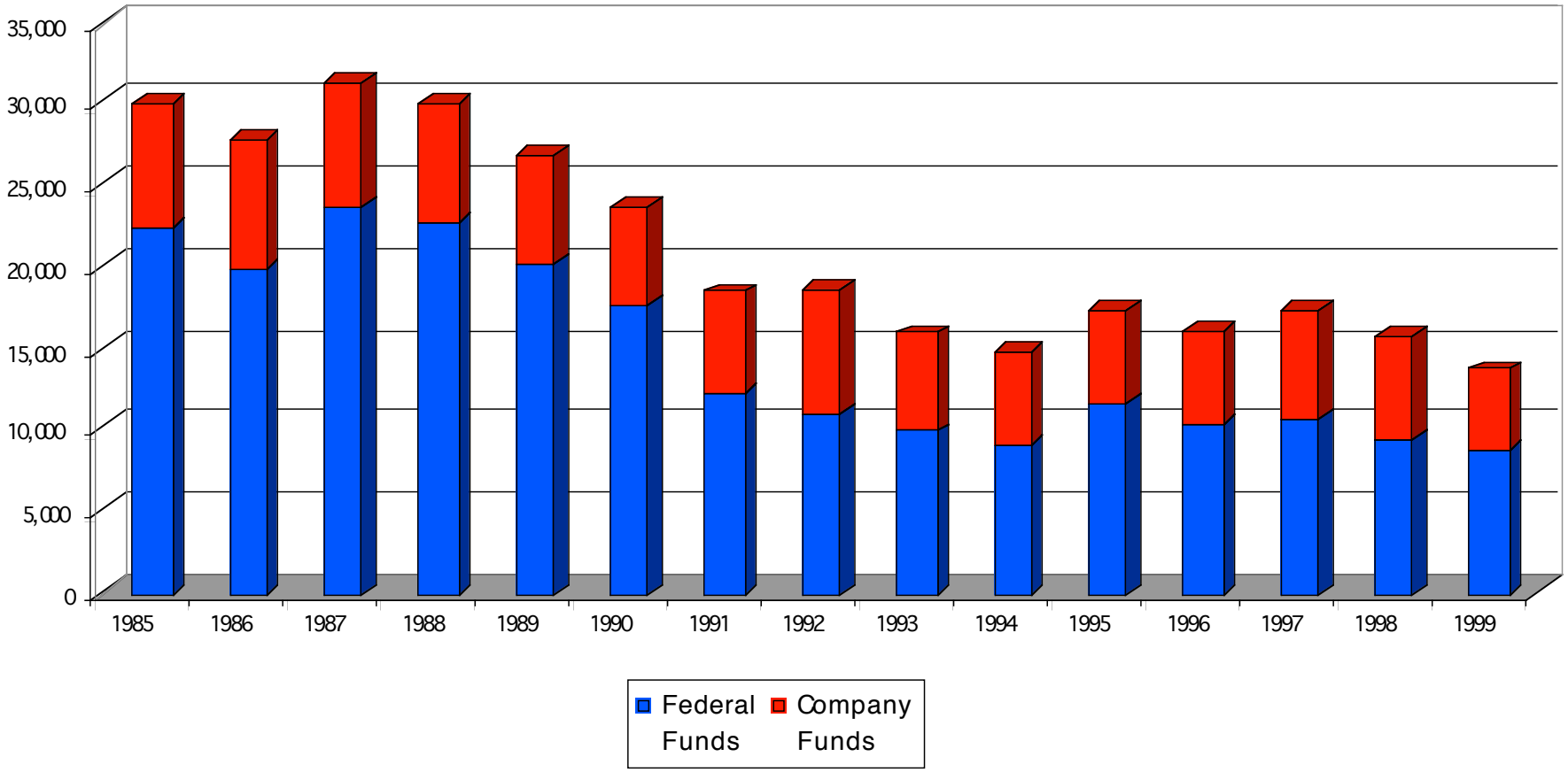
Total Projected Aircraft Market 1999 to 2008: $810 Billior



Source: National Academy of Sciences, Committee on Strategic Assessment of U.S. Aeronautics, Aeronautics and Space Engineering Board, "Recent Trends in Aeronautics Research and Technology (1999), p. 13.

THE U.S. HAS REDUCED AEROSPACE R&D EFFORTS

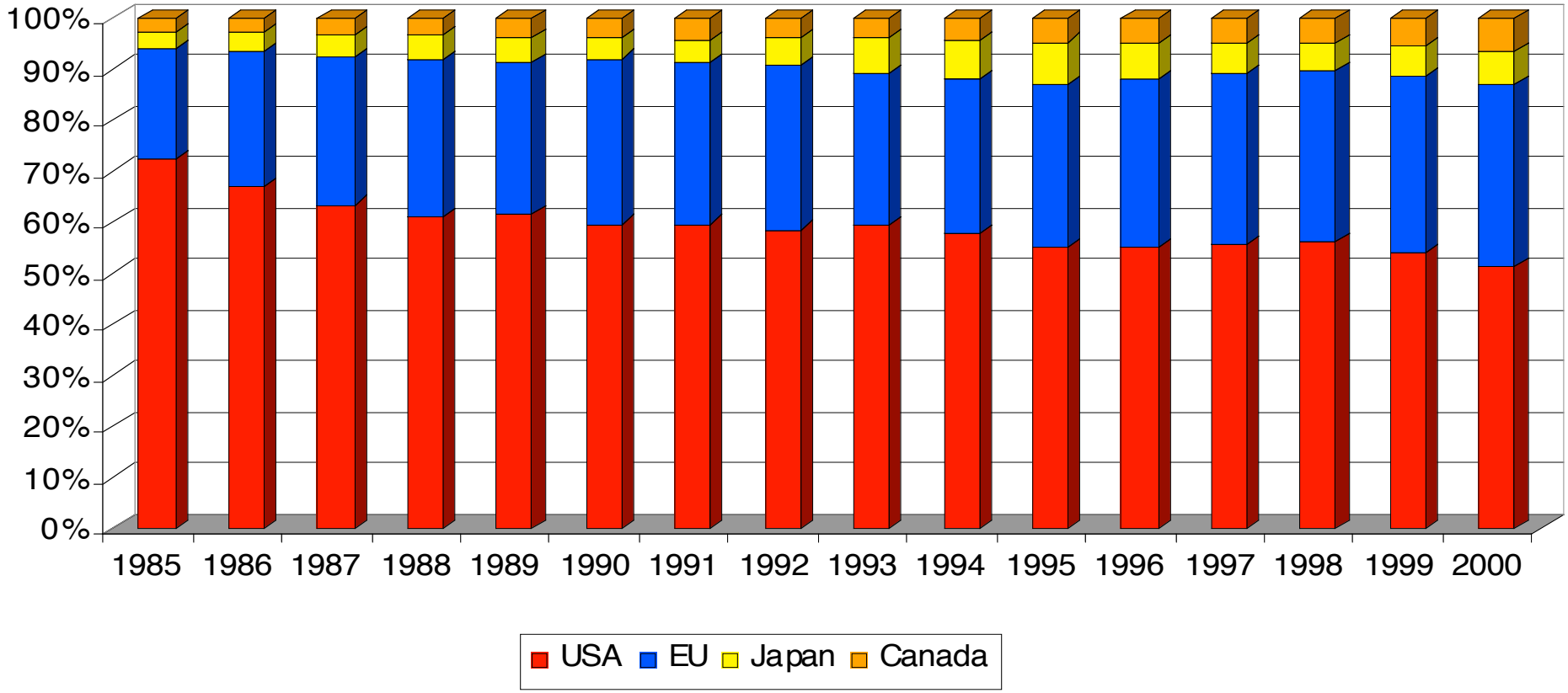
Funds for Industrial Research and Development in the Aerospace Industry*



*Companies classified in SIC codes 372 and 376, having as their principal activity the manufacture of aircraft, guided missiles, space vehicles, and parts.

Source: Aerospace Industries Association, *Aerospace Facts and Figures*, 2001-2002.

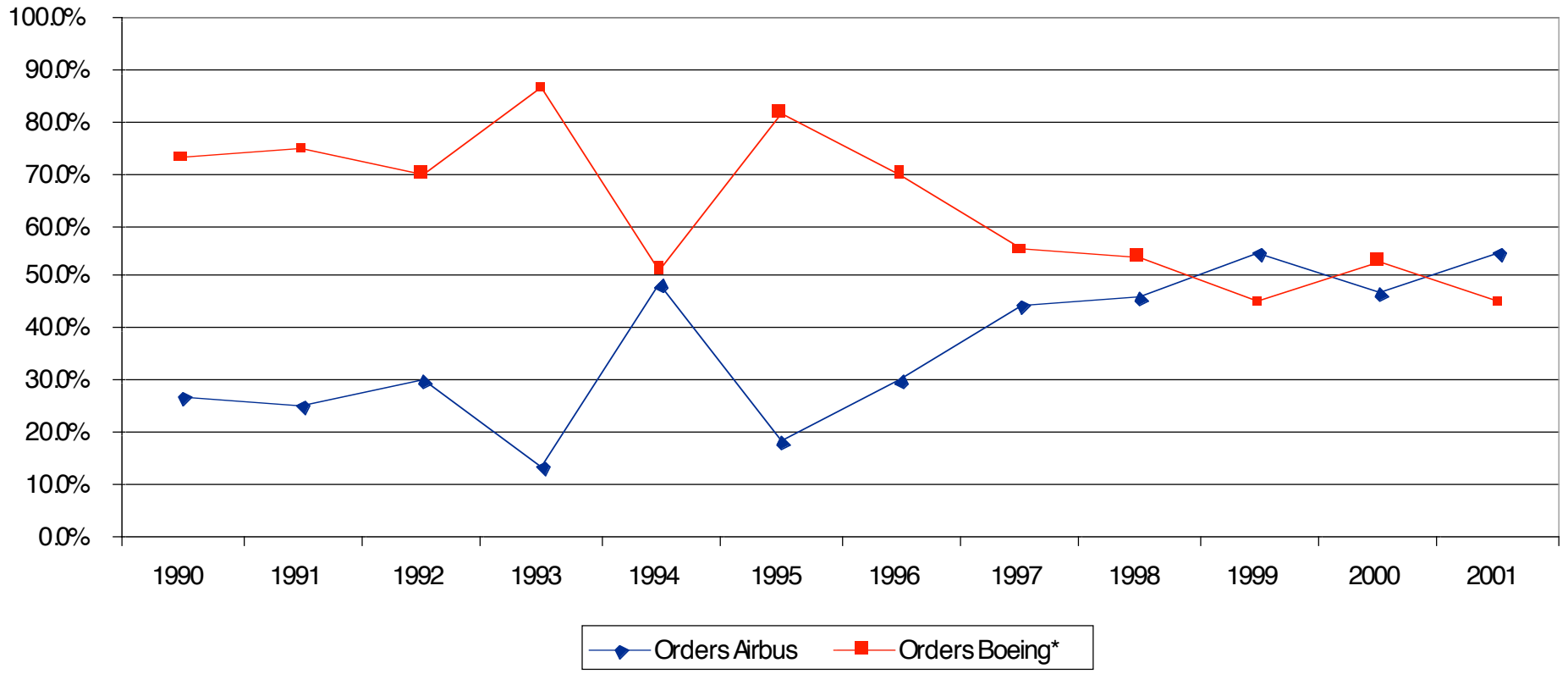
U.S. SHARE OF AEROSPACE MARKETS HAS FALLEN



Source: *Commission of the European Communities, Trading Position and Figures* (1997) for 1985 to 1995 data; and AECMA for 1996 to 2000 data.

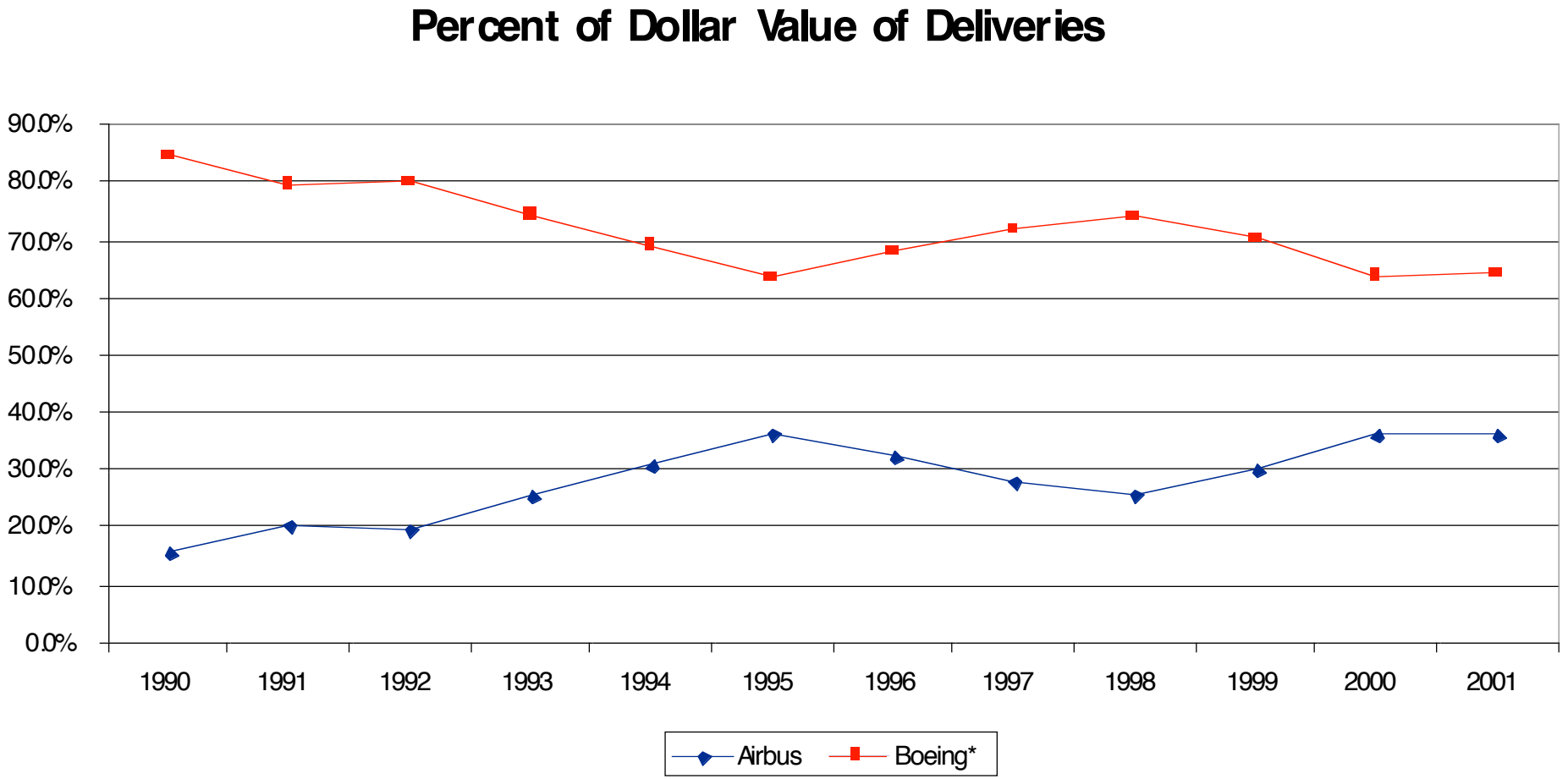
AIRBUS AND BOEING SHARE THE MARKET FOR LARGE COMMERCIAL TRANSPORTS

Percent Unit Orders: Airbus and Boeing



*Includes McDonnell Douglas
Source: Aviation Specialists Group

AIRBUS AND BOEING SHARE THE MARKET FOR LARGE COMMERCIAL TRANSPORTS

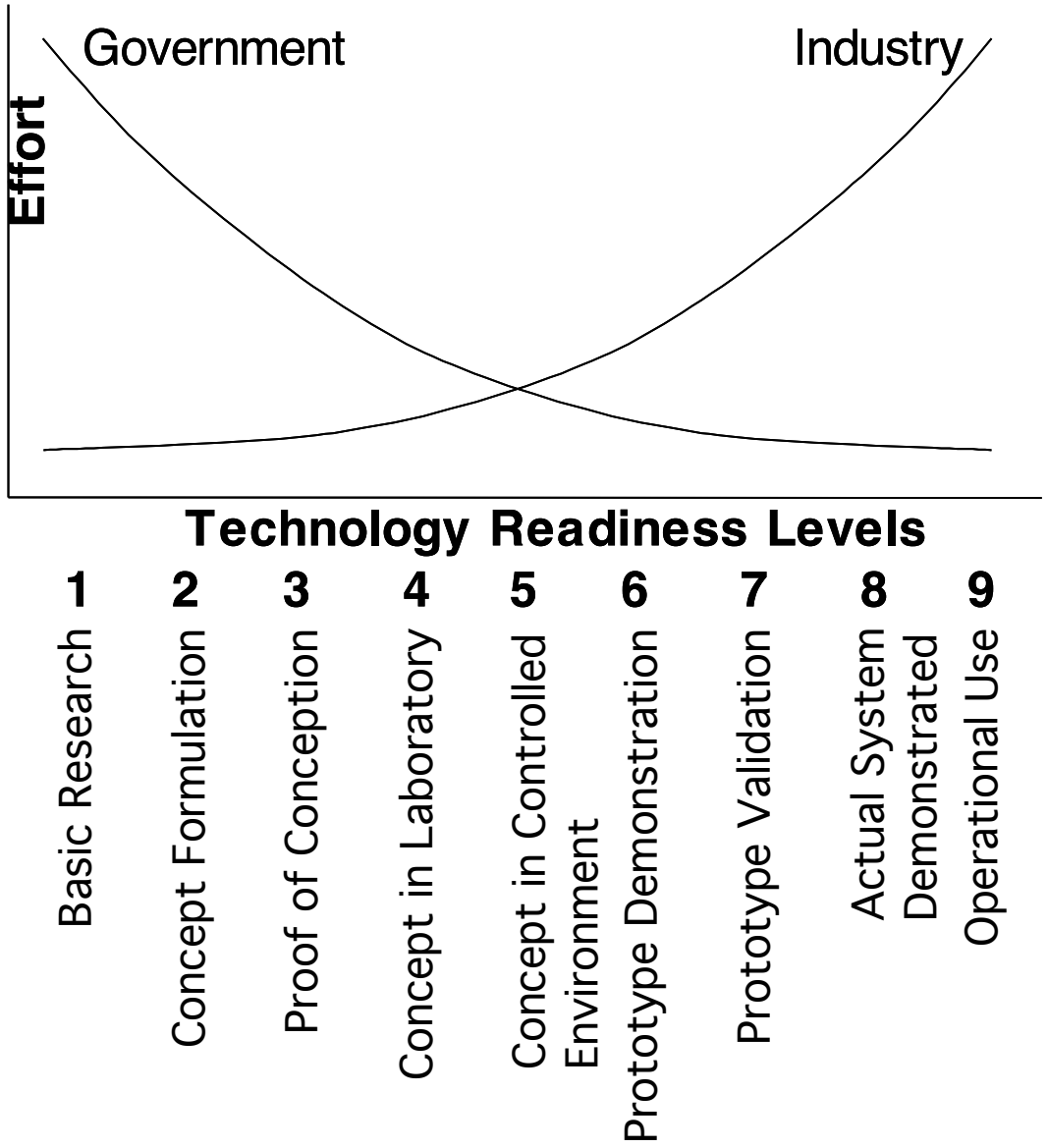


*Includes McDonnell Douglas
Source: Aviation Specialists Group

RATIONALE FOR GOVERNMENT INVESTMENT

- Public goods: National defense/aviation security
- Externalities (unpriced transactions)
  - Noise
  - Emissions
  - Safety
  - Capacity/delay reduction
- Appropriability: Ability of private sector to capture full returns
- Growth/high technology industries
  - High research intensity
  - Wide technology base
- International trade
  - Barriers to entry
  - Learning curves
  - Increasing returns

SPHERES OF INDUSTRY AND GOVERNMENT ACTIVITY



SAMPLE STATISTICS FOR NASA TECHNOLOGIES MATURING FROM TRL 1 TO TRL 9

Years to TRL 9 from TRL:		Average (years)	Standard Deviation
1	Basic Research	16.3	11.4
2	Concept Formulation	14.5	10.9
3	Proof of Conception	13.1	10.6
4	Concept in Laboratory	11.3	10.6
5	Concept in Controlled Environment	9.7	10.7
6	Prototype Demonstration	7.0	5.6
7	Prototype Validation	5.0	3.9
8	Actual System Demonstrated	2.2	3.1
9	Operational Use	0.0	0.0

Source: “Case Studies: Time Required to Mature Aeronautics Technologies to Operational Readiness,” prepared by SAIC and GRA, Incorporated, November 1999.

NEW DEVELOPMENTS ON GOVERNMENT ROLE

Increased productivity is key to higher standard of living and economic growth—R&D key to increased productivity

Strategic trade theory
- Declining costs
- Entry barriers

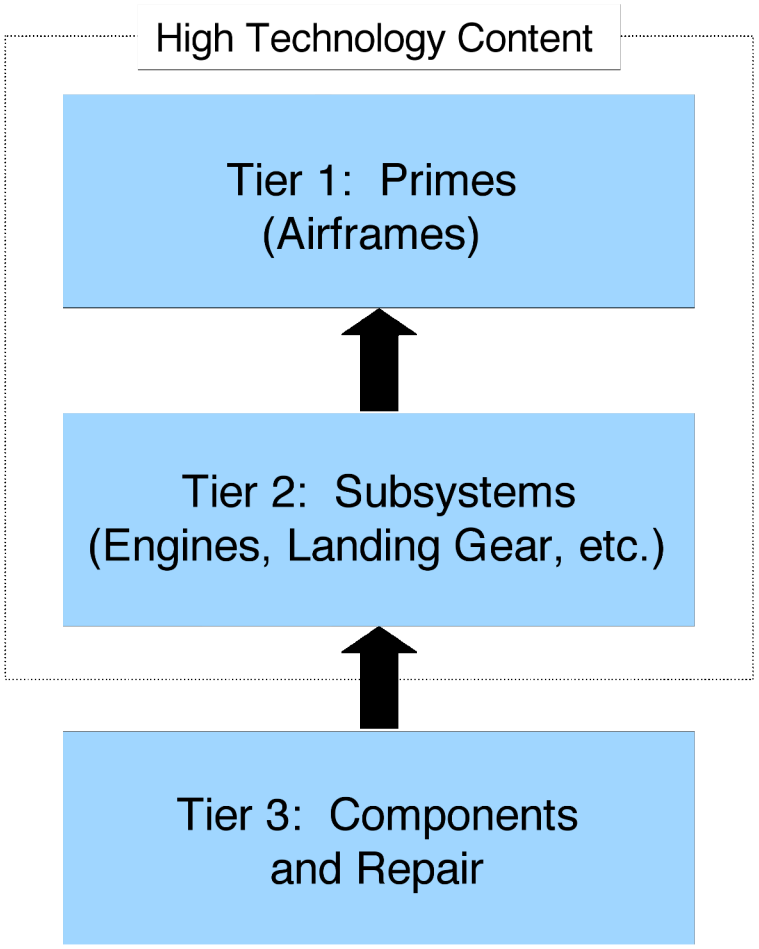
Increasing returns industries

Transportation networks and competitiveness
- Transportation cost reductions
- Enhanced mobility

Increased focus on the system that vehicles operate in
- Airports
- Air traffic management

THE 3 TIER WORLD AIRCRAFT INDUSTRY STRUCTURE

A Multi-Tiered Structure



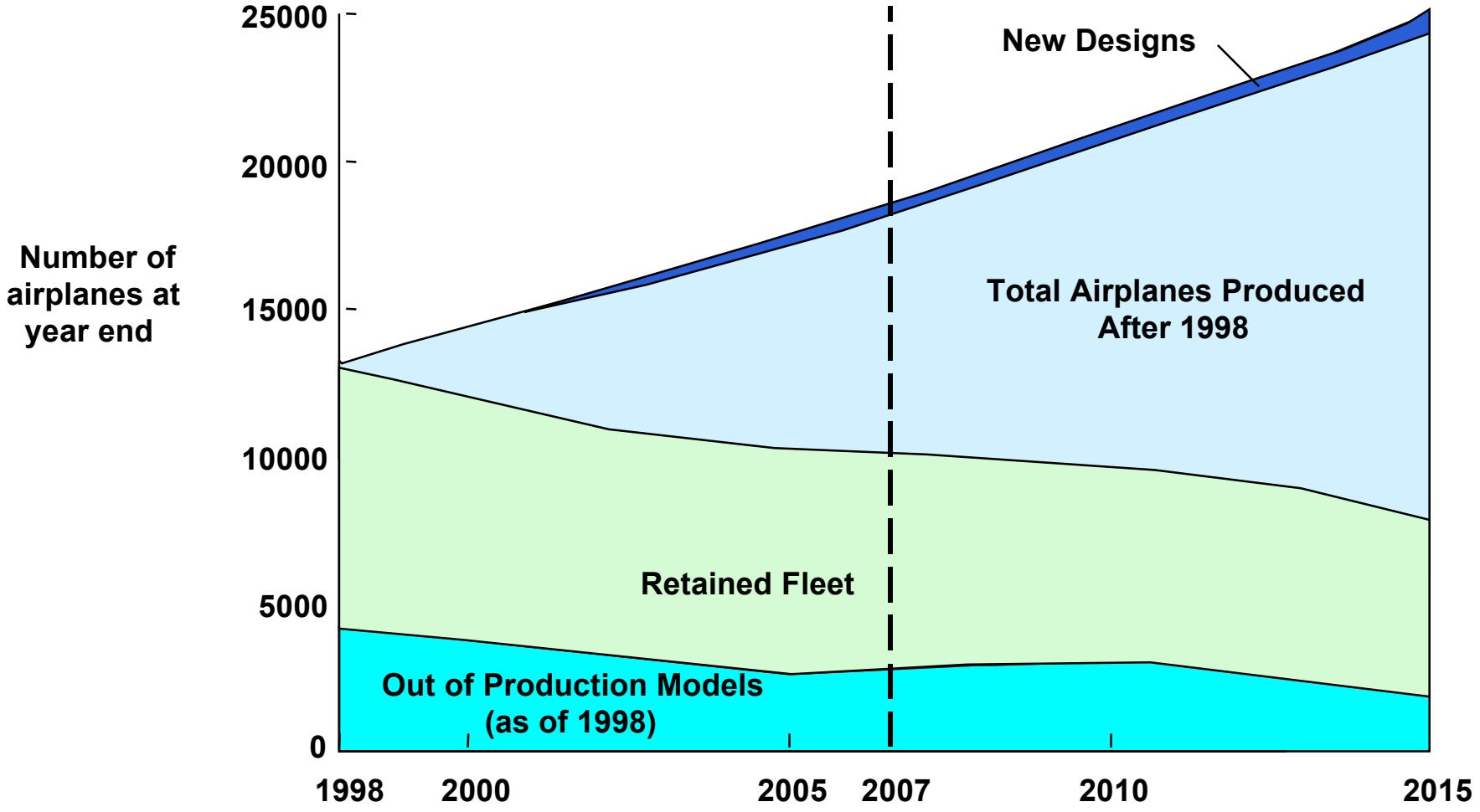
Design and specialized engineering
Product/process technology
Coordinate suppliers
Systems integration

Product/process technology
Specialized engineering
Advanced materials
Advanced techniques

Airframe structures and parts

Source: Adapted from Industry Canada, *The World Aircraft Industry, Part A Industry Structure,* 1995, http://strategis.ic.gc.ca/SSG/ad0115e.html

POTENTIAL FOR TECHNOLOGY TO AFFECT TOTALLY NEW AIRPLANE DESIGNS IS SMALL



Source: Boeing

SUPPORT OF FUTURE NAS

- Investments in technology that affect the system, or that can be retrofit may have larger near-term payoffs

- Collaborative roles
  - NASA R&T
  - FAA application

- Invest for risk reduction/validation
  - Make R&T implementable
  - No specific FAA R&D funding for incorporating NASA research results

- Need better handle on air transportation demand
  - Impacts of September 11th
  - Changes in security processes
  - Travel time and cost impacts
  - New airline business models

- The potential benefits of improved technology and processes for aviation security are large

RESEARCH LEVEL OF EFFORT

- Both public and private investment in aerospace R&D have fallen in real terms
  - Military and civil

- U.S. losing share to foreign competitors
  - Large transports
  - Regional jets
  - Rotary wing aircraft
  - Engines
  - Systems
  - ATC technology

- Need to fill gap prior to commercialization
  - Validation/risk reduction important for complex high consequence systems
  - Private sector may not have incentives to utilize research outcomes if too risky
  - Also applies to FAA adoption of NASA technology

U.S. VERSUS FOREIGN INDUSTRY-GOVERNMENT COLLABORATION

- Competition is global
- All countries support research
  - Military
  - Civil
  - Research laboratories/test facilities
- Foreign products are both quality and cost competitive
- Europeans also use repayable development grants
  - Per U.S./EU agreement
  - Rationale was state-owned companies/capital market failures
  - Reduces risks of technology application
  - Does infant industry rationale still hold?
- Increasing U.S. R&D as an effective counter strategy
  - Invest in technology validation/risk reduction
  - Avoid “picking winners”

SUMMARY

Strong rationale for government support of civil and military aeronautics R&T exists

Shift has been from traditional vehicle/performance technology to classic pubic goods

- Airport/ATC congestion/delay
- Engine emissions/noise
- National defense
- Safety

Europeans establishing strong aeronautics program that includes vehicle and performance technology components as well as ATC technology

- Frameworks program
- Vision 2020